HEALTH ECONOMIC ASSESSMENT TOOL FOR WALKING & CYCLING

Luc Int Panis, Michelle Laeremans, Evi Dons & Jurgen Buekers

INTRO

PASTA *Physcial Activity Through Sustainable Transport Approaches*

PASTA
PHYSICAL ACTIVITY THROUGH SUSTAINABLE TRANSPORT APPROACHES

European project, FP7 , 7 cities
[*https://www.researchgate.net/project/PASTA-project*](https://www.researchgate.net/project/PASTA-project)
Objectives:

- Promotion & evaluation of active mobility
- Reduce health impact of sedentary behaviour
- Integration of physical activity in daily routine
- Update WHO HEAT tool

Longitudinal study: online survey on (active) mobility, PM, accidents *etc*.

Experiments & Top Measure analysis

TIMESONLINE

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UK NEWS | WORLD NEWS | POLITICS | SCIENCE | ENVIRONMENT | WEATHER | TECH

Where am I? > Home > News > Environment

From The Sunday Times

May 30, 2010

Toxic cities mock 'hea...

Jonathan Leake,

17 COMMENT

CYCLING to wo... the healthy opti... has shown that ... cities inhale ten ... toxic nanopartic... breath, at least ... than drivers or p...

The research inv... cyclists with de... count the partic... emitted by car e... air they were bre...

It showed that u... concentrations ... which measure ... millionths of a m... reach several hu... in a cubic centir...

The particles, w... have been linked... disease and respiratory problems.

RELATED LINKS

- Tracking air pollution wth lichens
- Smoggy Delhi unveils giant air freshener

Cyclists inhale ... many toxic part... passengers, r...

Because they are ... themselves, cyclis... harder and faster t... users. The study f... suck in about 1,00... each breath, mean... inhale tens of milli... particles each time they fill their lungs, and billion... journey.

"This is the first time anyone has counted the particles while also measuring people's breathing during city commuting. It showed that cyclists can inhale an astonishing number of pollutant particles in one journey," said Luc Int Panis of the transport research institute at Hasselt University in Belgium, who led the

Cyklister inhalerer mest ... den partikelfyldte storby

Cyklister indånder giftige nanopartikler i større omfang end fodgængere og bilister, viser en ny undersøgelse.

VIJF TOT NEGEN KEER

Fietsers a... in

maandag 31 mei 2010

johan van cutsem

Elke dag een kwartier fietsen kan uw leven redden

Jeroen Zuallaert
Redacteur Knack

05/08/15 om 07:35 - Bijgewerkt om 09:52

Een kwartier fietsen per dag vermindert uw overlijdenskans met tien procent. Zelfs in de stad zijn de positieve effecten van lichaamsbeweging groter dan de negatieve effecten van luchtvervuiling.

1810 KEER GEDEELD

REACTIES 13

...οσοχή στο νέ...

...ές περιοχές η συγκέντρωση... ...ητα αρκετές εκατοντάδες χι... ...καρδιαγγειακές παθήσεις κα...

...τον εαυτό τους αναπνέουν τ... ...ς. Η μελέτη βρήκε ότι εισπνέ... ...ιτι μπορεί να εισπνέουν δεκά... ...δισεκατομμύρια αυτών σε κ...

...της μελέτης, Luc Int Panis α...

Envíe esta página por e-mail | Imprima esta nota

Viajar en bicicleta es sano, pero no tanto

NOTAS RELACIONADA...

AGENDA

Inactivity: a global health hazard

Health Economic Assessment for walking & cycling

- Why?
- What do we need?
- Relative risks & dose-response functions
- Monetary values for health

Case studies & available models

- The Health Economic Assessment Tool (HEAT) for walking & cycling
- Flemish model (CWIcalc)

Summary & conclusions

PHYSICAL INACTIVITY:
A GLOBAL HEALTH HAZARD

PHYSICAL INACTIVITY: A GLOBAL HEALTH HAZARD

4th most important cause of premature mortality

Active mobility

→ ☺ More physical activity (better health)

→ ☹ Increases exposure to air pollution

→ ☹ Increases accident risk

PHYSICAL INACTIVITY: A GLOBAL HEALTH HAZARD

Physical inactivity: a risk factor comparable to smoking

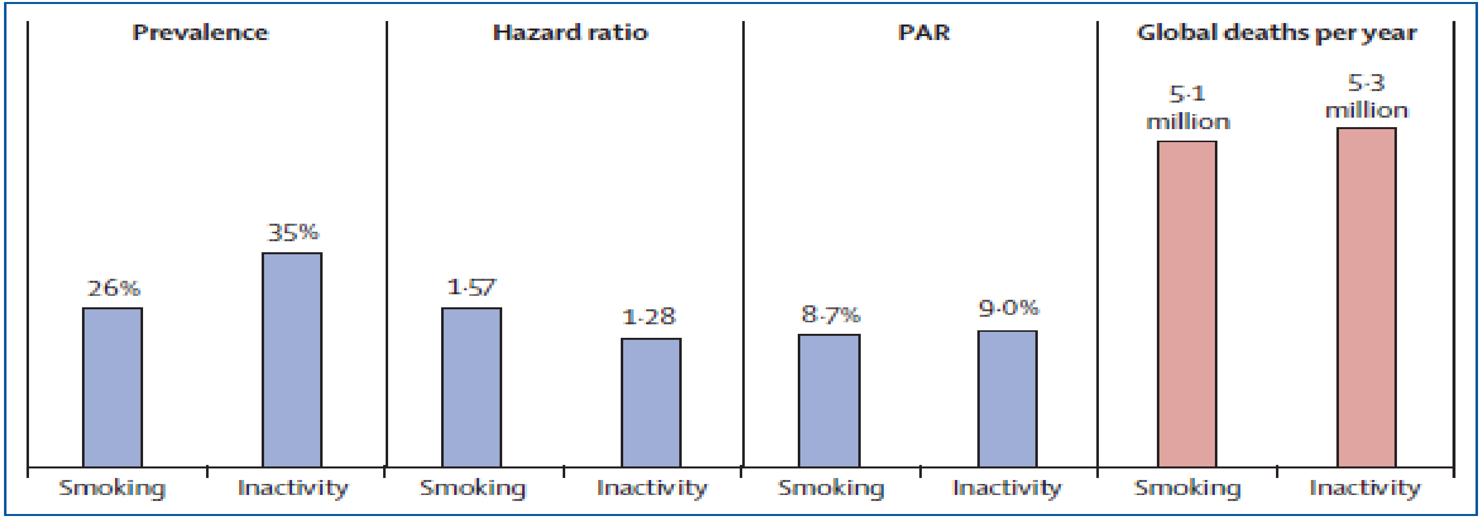


Figure: Comparison of global burden between smoking and physical inactivity
Prevalence of smoking, population attributable risk (PAR), and global deaths for smoking were obtained from WHO.[7] Hazard ratio for all-cause mortality of smoking was obtained from meta-analysis studies.[8,9] All inactivity data were obtained from Lee and colleagues.[5]

Source: The Lancet, 2012, http://dx.doi.org/10.1016/S0140-6736(12)61031-9

PHYSICAL INACTIVITY: A GLOBAL HEALTH HAZARD

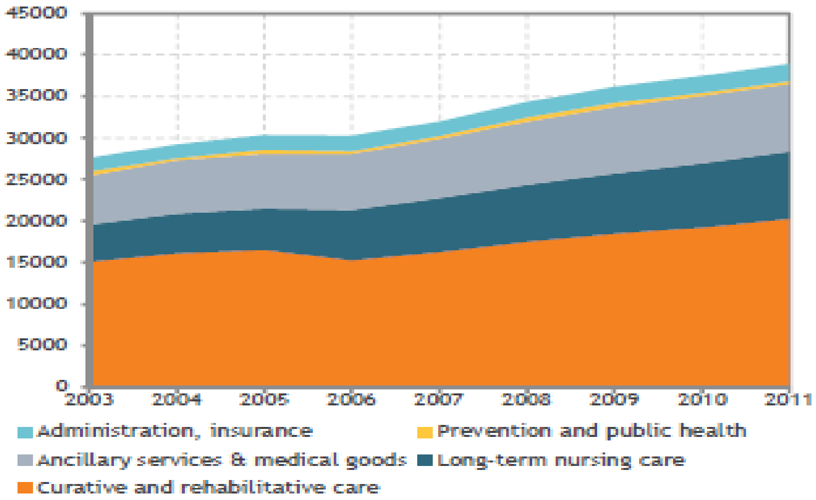
Impacts on health in Flanders

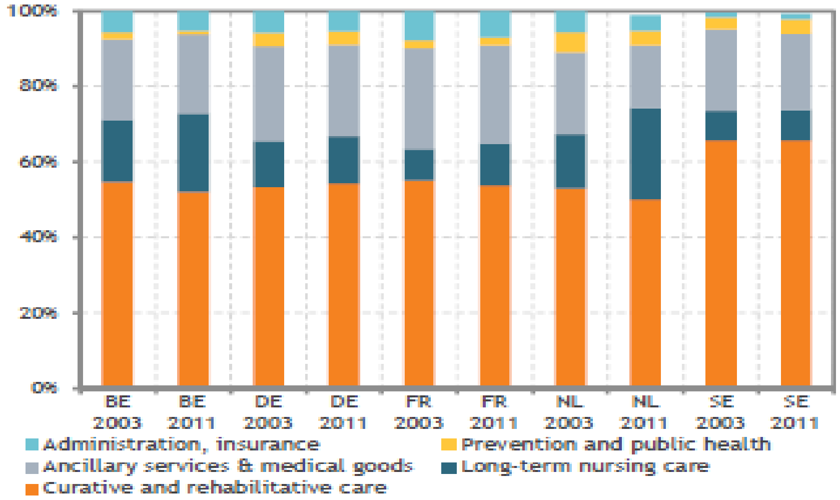
Risk	DALYs (avg/year)	Healthy life years lost (per capita)
Smoking	144687	1.9
Obesity	94750	1.3
Air pollution (PM)	79000	1.1
Physical inactivity	54134	0.7
Hypertension	53690	0.7
Traffic accidents*	36476	0.5
High holesterol	27930	0.4
Alcohol	10113	0.1
Passive smoking	6600	0.1
Tuberculosis	<1000	<0.01
Hepatitis B	<1000	<0.01

PHYSICAL INACTIVITY: A GLOBAL HEALTH HAZARD

Health expenditures, high & rising (but not for prevention)

Figuur 1 Functionele verdeling van de uitgaven voor gezondheidszorg in België en andere landen, 2003-2011





Bron: OESO, System of Health Accounts (SHA)

Source: De maatschappelijke betekenis van de gezondheidszorg; Karel Van den Bosch, Peter Willemé; januari 2014

THE HEALTH ECONOMIC ASSESSMENT TOOL FOR WALKING & CYCLING (HEAT)

HEALTH ECONOMIC ASSESSMENT TOOL (HEAT) FOR WALKING & CYCLING: A COLLABORATIVE PROJECT

Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

NATURAL ENGLAND

World Health Organization
REGIONAL OFFICE FOR Europe

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

THE PEP Transport, Health and Environment Pan-European Programme
UNITED NATIONS ECONOMIC COMMISSION FOR EUROPE
World Health Organization REGIONAL OFFICE FOR Europe

Harry Rutter, Francesca Racioppi, Sonja Kahlmeier, Nick Cavill, Pekka Oja, Heini Sommer, Hywell Dinsdale, Charlie Foster, Paul Kelly, Thomas Götschi, Christian Schweizer

Karim Abu-Omar, Lars Bo Andersen, Finn Berggren , Tegan Boehmer, Nils-Axel Braathen, Dushy Clarke, Andy Cope, Audrey de Nazelle, Mark Fenton, Jonas Finger, Richard Fordham, Eszter Füzeki, Frank George, Regine Gerike, Mark Hamer, Max Herry, Marie-Eve Heroux, Michal Krzyzanowski, I-Min Lee, Christoph Lieb, Brian Martin, Markus Maybach, Christoph Schreyer, Marie Murphy, Nanette Mutrie, Luc Int Panis, Laura Perez, Gabe Rousseau, David Rojas Rueda, Candace Rutt, Tom Schmid, Elin Sandberg, Mulugeta Yilma, Daniel Sauter, Peter Schantz, Peter Schnohr, Dave Stone, Jan Sørensen, Gregor Starc, James Woodcock, Wanda Wendel Vos, Paul Wilkinson

HEAT FOR WALKING & CYCLING: WHY & HOW?

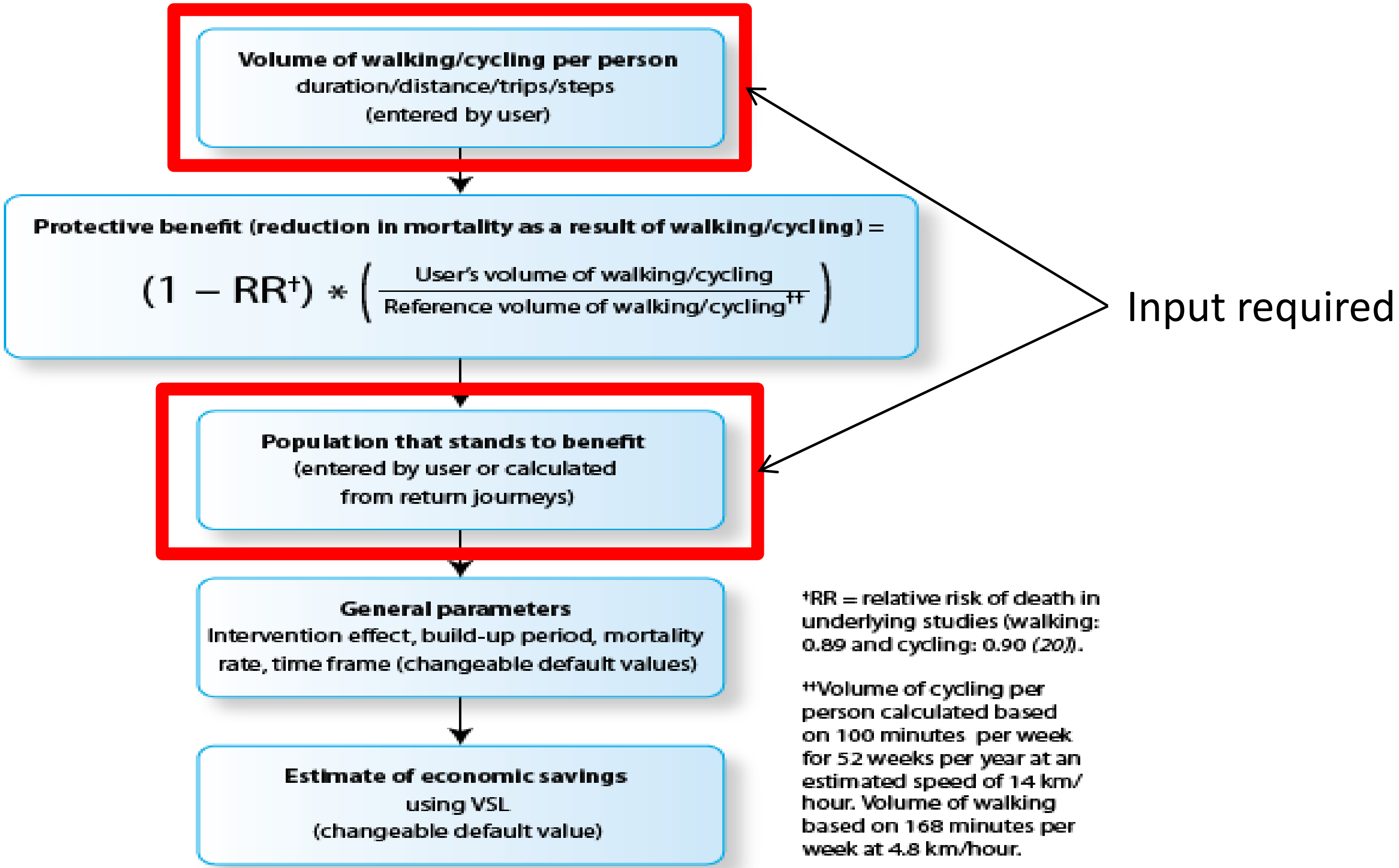
Need for integration between different policy domains
(transport, urban planning, health, etc.)

HEAT:
User friendly tool to estimate economic value of health benefits of cycling & walking

Answer the question:

"For a given volume of walking or cycling what is the economic value of the health benefits?"

Inputs:
- Data on 'volume' of walking or cycling
- How many people?
- Which people?
- How far/often?



Volume of walking/cycling per person
duration/distance/trips/steps
(entered by user)
Protective benefit (reduction in mortality as a result of walking/cycling) =
$(1 - RR^{\dagger}) * \left(\frac{\text{User's volume of walking/cycling}}{\text{Reference volume of walking/cycling}^{\dagger\dagger}} \right)$
Population that stands to benefit
(entered by user or calculated
from return journeys)
General parameters
Intervention effect, build-up period, mortality rate, time frame (changeable default values)
Estimate of economic savings
using VSL
(changeable default value)
Input required
†RR = relative risk of death in underlying studies (walking: 0.89 and cycling: 0.90 *(20)*).
††Volume of cycling per person calculated based on 100 minutes per week for 52 weeks per year at an estimated speed of 14 km/hour. Volume of walking based on 168 minutes per week at 4.8 km/hour.

HEAT FOR WALKING & CYCLING: RELATIVE RISKS & DOSE-RESPONSE

1st HEAT for cycling version: based on Copenhagen only:

- Dose: 3h cycling; 36 weeks/year
- Response: RR 'all-cause mortality' = 0.72
- Corrected for leisure time PA
  - → Lots of criticisms
  - → But nevertheless very conservative

2nd HEAT version : Meta-analysis (7 studies):

- Dose: 11.25 MET.hours/week or 100 minutes cycling/week; 52 weeks/year (cycling = 6.8 METs)
- Response: RR 'all-cause mortality' = 0.90
- Corrected for leisure time PA
  - → Even more conservative
  - → Maximum 'protective benefit' (cycling = 45%)

New HEAT version 2018 (Beta version currently being tested, Manual also in German & French)

https://www.researchgate.net/publication/275219139_Health_impact_assessment_of_active_transportation_A_systematic_review/stats

HEAT FOR WALKING & CYCLING: RELATIEVE RISICO'S & DOSIS-RESPONS RELATIE

ORIGINAL INVESTIGATION

All-Cause Mortality Associated With Physical Activity During Leisure Time, Work, Sports, and Cycling to Work

Lars Bo Andersen, PhD, DMSc; Peter Schnohr, MD; Marianne Schroll, PhD, DMSc; Hans Ole Hein, MD

Background: Physical activity is associated with low mortality in men, but little is known about the association in women, different age groups, and everyday activity.

Objective: To evaluate the relationship between levels of physical activity during work, leisure time, cycling to work, and sports participation and all-cause mortality.

Design: Prospective study to assess different types of physical activity associated with risk of mortality during follow-up after the subsequent examination. Mean follow-up from examination was 14.5 years.

Setting: Copenhagen University Hospital, Copenhagen, Denmark.

Participants: Participants were 13375 women and 17265 men, 20 to 93 years of age, who were randomly selected. Physical activity was assessed by self-report, and health status, including blood pressure, total cholesterol level, triglyceride levels, body mass index, smoking, and educational level, was evaluated.

Main Outcome Measure: All-cause mortality.

Results: A total of 2881 women and 5668 men died. Compared with the sedentary, age- and sex-adjusted mortality rates in leisure time physical activity groups 2 to 4 were 0.68 (95% confidence interval, 0.64-0.71), 0.61 (95% confidence interval, 0.57-0.66), and 0.53 (95% confidence interval, 0.41-0.68), respectively, with no difference between sexes and age groups. Within the moderately and highly active persons, sports participants experienced only half the mortality of nonparticipants. Bicycling to work decreased risk of mortality in approximately 40% after multivariate adjustment, including leisure time physical activity.

Conclusions: Leisure time physical activity was inversely associated with all-cause mortality in both men and women in all age groups. Benefit was found from moderate leisure time physical activity, with further benefit from sports activity and bicycling as transportation.

Arch Intern Med. 2000;160:1621-1628

BICYCLING TO WORK

Information on bicycling as transportation to work was available for 783 women and 6171 men. Among these 6954 subjects, 2291 died during follow-up. The same tendencies were found in men and women when mortality rates were compared between those who cycled to work and those who did not, but the estimates were not significant in women. The average time spent cycling in those who did cycle to work was 3 hours per week. The analyses are presented for the whole group, with adjustment for sex. Bicycling to work was inversely related to years of education. Among the less educated subjects (<8 years of school), 27.8% used the bicycle to work, in the middle group (8-12 years of school) 24.5% cycled, and in the most educated group (≥12 years of school) 20.3% cycled. After adjustment for age, sex, and educational level, the relative risk in those who cycled was 0.70 (95% CI, 0.55-0.89). After additional adjustment for leisure time physical activity, body mass index, blood lipid levels, smoking, and blood pressure, the relative risk was 0.72 (95% CI, 0.57-0.91).

HEAT FOR WALKING & CYCLING: MONETARY VALUATION OF HEALTH BENEFITS

‘Value of a Statistical Life’ (VSL)

- ‘willingness to pay’ to reduce mortality risk e.g. from 3/10000 to 2/10000?
- Different for each country

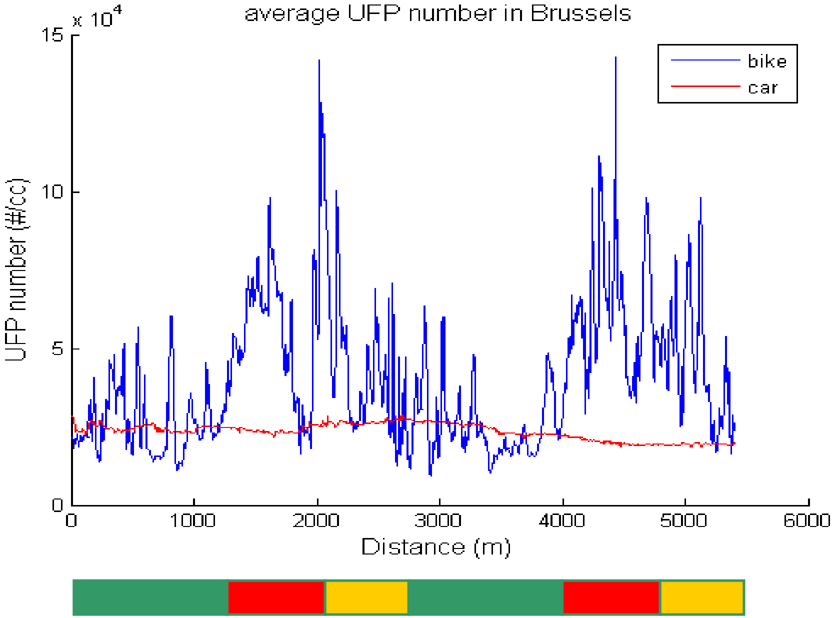
WHO European region average	2 587 175 EUR
België	4 380 597 EUR
Hongarije	1 576 768 EUR

Should be discounted

HEAT FOR WALKING & CYCLING:WHAT IS/WAS MISSING?

- Interaction between transport related PA & air pollution
- Accidents/crashes
- Morbidity
- Climate
- Noise
- Social
- …

HIGH AIRPOLLUTION CONCENTRATION ON CYCLE LANES



Near "park"
(Louisa Square, KDG avenue)

"Busy street canyon" rue de la Loi

"Quiet street" (rue Jozef II)

ACCIDENTS/CRASHES

Review

Do the Health Benefits of Cycling Outweigh the Risks?

Jeroen Johan de Hartog,[1] Hanna Boogaard,[1] Hans Nijland,[2] and Gerard Hoek[1]

[1]University of Utrecht, Institute for Risk Assessment Sciences, Utrecht, the Netherlands; [2]Netherlands Environmental Assessment Agency, Bilthoven, the Netherlands

BACKGROUND: Although from a societal point of view a modal shift from car to bicycle may have beneficial health effects due to decreased air pollution emissions, decreased greenhouse gas emissions, and increased levels of physical activity, shifts in individual adverse health effects such as higher exposure to air pollution and risk of a traffic accident may prevail.

OBJECTIVE: We describe whether the health benefits from the increased physical activity of a modal shift for urban commutes outweigh the health risks.

DATA SOURCES AND EXTRACTION: We have summarized the literature for air pollution, traffic accidents, and physical activity using systematic reviews supplemented with recent key studies.

DATA SYNTHESIS: We quantified the impact on all-cause mortality when 500,000 people would make a transition from car to bicycle for short trips on a daily basis in the Netherlands. We have expressed mortality impacts in life-years gained or lost, using life table calculations. For individuals who shift from car to bicycle, we estimated that beneficial effects of increased physical activity are substantially larger (3–14 months gained) than the potential mortality effect of increased inhaled air pollution doses (0.8–40 days lost) and the increase in traffic accidents (5–9 days lost). Societal benefits are even larger because of a modest reduction in air pollution and greenhouse gas emissions and traffic accidents.

CONCLUSIONS: On average, the estimated health benefits of cycling were substantially larger than the risks relative to car driving for individuals shifting their mode of transport.

KEY WORDS: air pollution, biking, cycling, life table analysis, modal shift, physical activity, traffic accidents. *Environ Health Perspect* 118:1109–1116 (2010). doi:10.1289/ehp.0901747 [Online 30 June 2010]

In the quantitative comparison between car driving and cycling, we considered air pollution, traffic accidents, and physical activity as main exposures. We summarize the relevant evidence of health effects related to air pollution, traffic accidents, and physical activity separately. For these sections, we made use of published (systematic) reviews, supplemented with more recent key studies.

Health effects related to air pollution, traffic accidents, and physical activity differ—for example, traffic accidents resulting in injuries and physical activity affecting cardiovascular disease. Therefore, we compare potential effects of these exposures (in conjunction with driving or cycling) on mortality rather than morbidity. In addition, epidemiologic evidence of associations of these exposures with mortality is stronger than associations with other outcomes, particularly for physical activity. All three exposures have been associated with mortality, so a common metric can

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Cycling: Health Benefits and Risks

doi:10.1289/ehp.1003227

de Hartog et al. (2010) quantified the balance between physical activity and air pollution and accident risks of cycling and concluded that the benefits outweigh the risks by an order of magnitude. This is the most comprehensive and quantitative comparison to date, based on the published data available at the time. In the weeks after publication of the article, two new relevant studies were published; this illustrates that a scientific answer to this question is urgent from the societal perspective. In many places cyclists are perceived to have a higher exposure to air pollution and a higher accident risk. Do the new data tilt the balance between the risks and benefits of cycling?

de Hartog et al. (2010) used a ventilation rate that is twice as high for cyclists as for car drivers. In a recent study in Belgium (Int Panis et al. 2010), we found that both the ventilation rate and the tidal volume were increased and that minute ventilation was 4.3 times higher in cyclists compared with car passengers (similar to the ratio of metabolic rates). The difference can further be explained by differences in cycling speeds and lung deposition resulting in a dose that is up to 9 times higher in cyclists.

The life expectancy (LE) loss estimated from substituting this ratio into the calculation by de Hartog et al. (2010) may thus offset most of the expected LE gain. However, this is unlikely because some studies have observed an LE gain in the presence of air pollution (Andersen et al. 2000). To resolve this conflict, it is important to consider the implicit assumptions in the comparison.

First, the higher dose ratios apply only to situations without route choice, although cyclists prefer to avoid motorized traffic, which exposes them to lower concentrations LE loss or those in which many people have a small loss (Rabl 2003). Cyclists are generally young and in excellent health and therefore less vulnerable, implying that the relative risk used by de Hartog et al. (2010) is too high for application to this specific population.

In addition, accidents remain an important cause for concern. Aertsens et al. (2010) recently estimated the cost of minor bicycle accidents at an astonishing 0.12€/km cycled. Including the more serious accidents in the equation would yield a cost that could easily offset the value of the LE benefit calculated by de Hartog et al. (2010).

If the higher LE observed in present day cyclists can be transferred to people now taking up cycling, the benefits will probably be higher than the risks. However, it will be crucial to demonstrate that cycling increases physical activity. Without increased physical activity there are only risks, but reducing those risks may yield larger benefits than anticipated.

The views and opinions expressed in this article are those of the author and not necessarily those of his employer.

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References

Cycling: de Hartog et al. Respond

doi:10.1289/ehp.1003227

We thank Int Panis for his thoughtful comments on our article (de Hartog et al. 2010), and we broadly agree with his comments. In fact, we discussed most of the issues—including the limitation to impact on mortality, sensitive subgroups, route choice, and activity substitution—in our paper.

The first issue discussed by Int Panis is whether we underestimated the difference in minute ventilation between cyclists and car drivers; however, his comment was based on a recent Belgian study (Int Panis et al. 2010) that was not published at the time of our study. In our analysis we used a ratio of 2.2 [the average of two Dutch studies that closely agreed (van Wijnen et al. 1995; Zuurbier et al. 2009)], whereas the Belgian study (Int Panis et al. 2010) found a ratio of 4.3. The difference is probably explained in part by differences in cycling speed: 12 km/hr in the recent Dutch study (Zuurbier et al. 2009) and > 19 km/hr in the Belgian study (Int Panis et al. 2010). In urban areas, the average cycling speed is about 15 km/hr, including stop time. Rather than replacing the previous estimates by with the newer Belgian estimate, we believe that the best current estimate would be the average of the ratios of the three available studies. This would lead to a ratio of 2.9. Use of this ratio based on more studies clearly would not tip the balance between cycling and car driving as Int Panis suggests. We think it is stretching the data too much to use deposited particle mass (actually 5.9–8.99 higher in the Belgian study) for the analysis, because the long-term epidemiological studies we used are based on concentrations measured in outdoor air. In the most likely estimate we provided for air pollution [based on black smoke, which better represents traffic exposures than $PM_{2.5}$

HEAT FOR WALKING & CYCLING: WHAT IS/WAS MISSING?

De Hartog et al. 2010

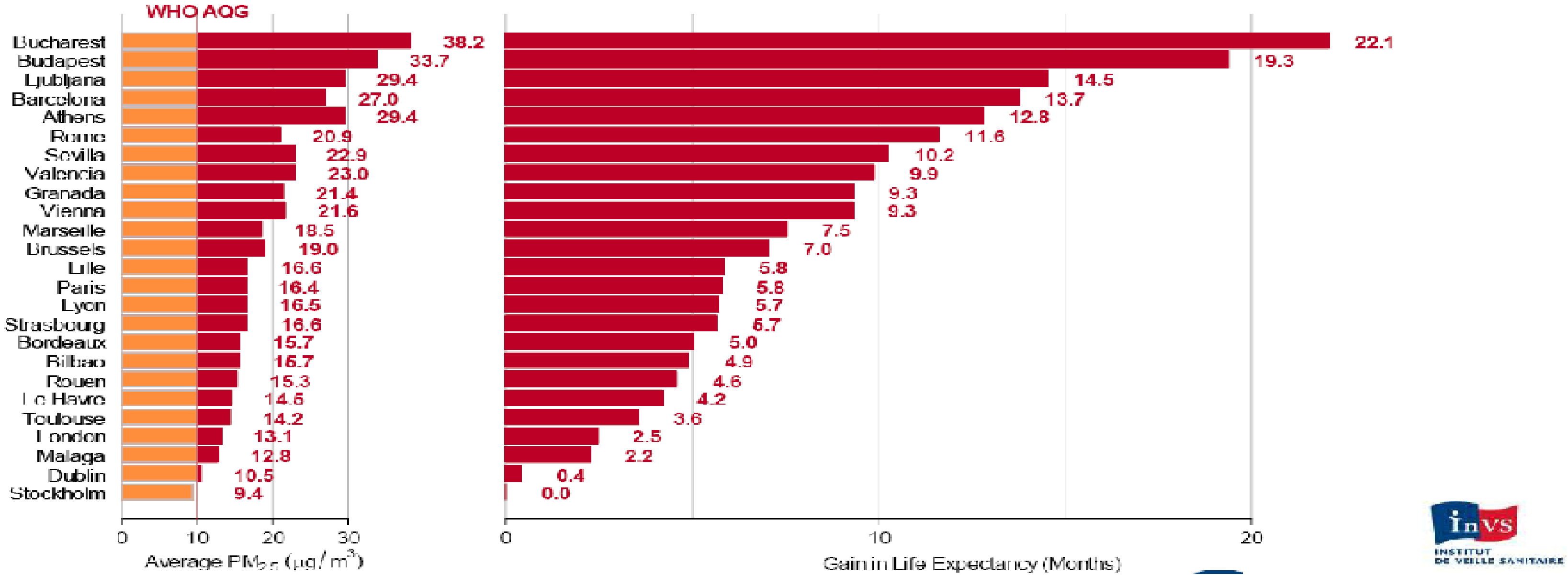
What if:

500 000 people switch from car to bike for daily short trips?

- More air pollution exposure: 0.8-40 days lost
- Accidents: 5-9 days lost
- Increased physical activity: 3-14 months gained
- Benefits even larger if social benefits are included

No morbidity impacts included in most studies or models (increases complexity & uncertainty)

HEAT FOR WALKING & CYCLING: AIR POLLUTION IS HARD TO EXTRAPOLATE



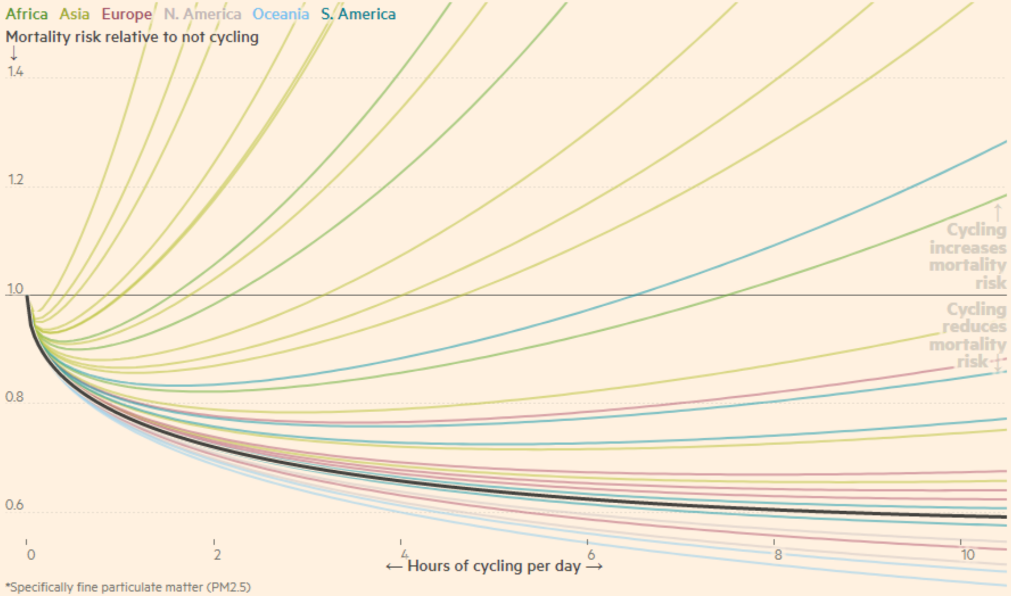
Source: Presentation of Aphekom findings at the Policy Workshop: EU Year of Air – how can we reduce air pollution to improve health? 13 September 2012, Brussels, Belgium, http://www.aphekom.org/c/document_library/get_file?uuid=e5e5777f-968c-484c-8a51-652f132030c7&groupId=10347

vito

AIR POLLUTION IS USUALLY NOT A PROBLEM IN EUROPE

How long could you cycle in your city before the negative impacts of pollution would outweigh the benefits of exercise?

You could cycle *literally* all day before harm from pollution would outweigh the health benefits from exercise



*Specifically fine particulate matter (PM2.5)
Sources: Tainio, M. et al, 2016, King's College London
Graphic by John Burn-Murdoch / @jburnmurdoch

Woodcock, Tainio et al https://ig.ft.com/sites/urban-cycling/

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HEAT FOR WALKING & CYCLING: CONCRETE

What?

- Planning of new projects (infrastructure or other)
  - Monetise health benefits of estimated use

- Evaluation of finished projects
  - Monetise health benefits of observed change in use

As part of general economic evaluation of transportation projects
(e.g. relative to cost of investment, ROI, …)

CASE STUDIES

http://oldheatwalkingcycling.org

Example 1:
Cycling bridge over ring road in Antwerp
Connects Bicycle highway F1 (Antwerpen-Mechelen) with Berchem train station and city center.

Expectations:
- New cyclists
- Safer
- Faster (traffic lights)

HEAT FOR WALKING & CYCLING: CASE STUDY

Q1: Your data: amount of cycling from a single point in time, or before and after an intervention

- Single point in time
- Before and after

Q2: Enter your pre-intervention cycling data

- Duration
- Distance
- Trips

Q4: Pre-intervention cycling data

- Average distance cycled/day: 28 km
- Number of days per year: 200

Q7: How many people benefit ?

- Number of cyclists: 2365

High level of cycling
5600 km/person/year
Protective benefit: 45%

HEAT FOR WALKING & CYCLING: CASE STUDY

Q2: Enter your post-intervention cycling data

- Duration
- Distance
- Trips

Q4: Post-intervention cycling data

- Average distance cycled/day: 28 km
- Number of days per year: 200
- Q7: How many people benefit
- Number of cyclists: 2601

High level of cycling
5600 km/person/year
Protective benefit: 45%

- Q9: How much of the change is attributed to the intervention
- Proportion: 100%

Q10: Time needed to reach full level of cycling

- Years: 1 year

- Q11: mortality rate
  - Age
- Average population (20-64 years old)
- Younger average population (20-44 years old)
- Older average population (45-64 years old)
- Country mortality data: Belgium (524 deaths/100000 persons/year)

HEAT FOR WALKING & CYCLING: CASE STUDY

- Q9: How much of the change is attributed to the intervention

•Proportion: 100%

Q10: Time needed to reach full level of cycling

•Years: 1 year

- Q11: mortality rate
  - Age

•Average population (20-64 years old)

•Younger average population (20-44 years old)

•Older average population (45-64 years old)

•Country mortality data: Belgium (524 deaths/100000 persons/year)

Q12: Value of a statistical life?

- Belgium (4 380 597 Euro)
- Q13: Time period over which benefits are calculated?
- Years: 10 years
- Q14: Costs to include a benefit-cost ratio in the HEAT calculation?
- Yes
- No

Q15: Cost associated with promoting cycling?

- Total costs: 4 000 000 Euro
- Duration to calculate benefit-cost ratio: 10 years (standard this is equal to Q13)

Q16: Discount rate to apply to future benefits: 5%

HEAT FOR WALKING & CYCLING: CASE STUDY

HEAT estimate

Reduced mortality as a result of changes in cycling behaviour

The number of individuals cycling has **increased** between your pre and post data.
There are now **236 additional** individuals regularly cycling, compared to the baseline.

However, the average amount of cycling per person per year has not changed.
The reported level of cycling in both your pre and post data gives a reduced risk of mortality of: **45 %**, compared to individuals who do not regularly cycle.

Taking this into account, the number of deaths per year that are prevented by this change in cycling is: **0.56**

HEAT FOR WALKING & CYCLING: CASE STUDY

Financial savings as a result of cycling

Currency: EUR, rounded to 1000

The value of statistical life applied is: **4,381,000**	
The annual benefit of this level of cycling, per year, is:	**1,815,000**
The total benefits accumulated over **10** years are:	**18,146,000**
When future benefits are discounted by **5** % per year:	
the current value of the average annual benefit, averaged across 10 years is:	**1,321,000**
the current value of the total benefits accumulated over 10 years is:	**13,214,000**

Benefit–Cost Ratio

The total costs of:	**4,000,000**
Should produce a total saving over **10** years of:	**13,214,000**
assuming **5** year build up of benefits, **1** years build up of uptake, and discounting of **5** % per year	
The benefit to cost ratio is therefore:	**3.30:1**

Please bear in mind that HEAT does not calculate risk reductions for individual persons but an average across the population under study. The results should not be misunderstood to represent individual risk reductions. Also note that the VSL not assign a value to the life of one particular person but refers to an average value of a "statistical life".

It is important to remember that many of the variables used within this HEAT calculation are estimates and therefore liable to some degree of error.

You are reminded that the HEAT tools provide you with an approximation of the level of health benefits. **To get a better sense for the possible range of the results, you are strongly advised to rerun the model**, entering slightly different values for variables where you have provided a "best guess", such as entering high and low estimates for such variables.

Back | Print | Save | Start a new calculation http://oldheatwalkingcycling.org

Example 2:
Estimate the value of the present level of walking on an existing trail in Belgium.

100 elderly people walk 3 km every day

What is the value of that level of physical activity over 10 years?

HEAT FOR WALKING & CYCLING: CASE STUDY


HEAT
Health economic
assessment tool

HEAT
Health economic
assessment tool

News / Announcements
Introduction
HEAT for walking
HEAT for cycling
Examples of applications
Return to current assessment

Home ▶ HEAT for walking ▶ Scope for the use

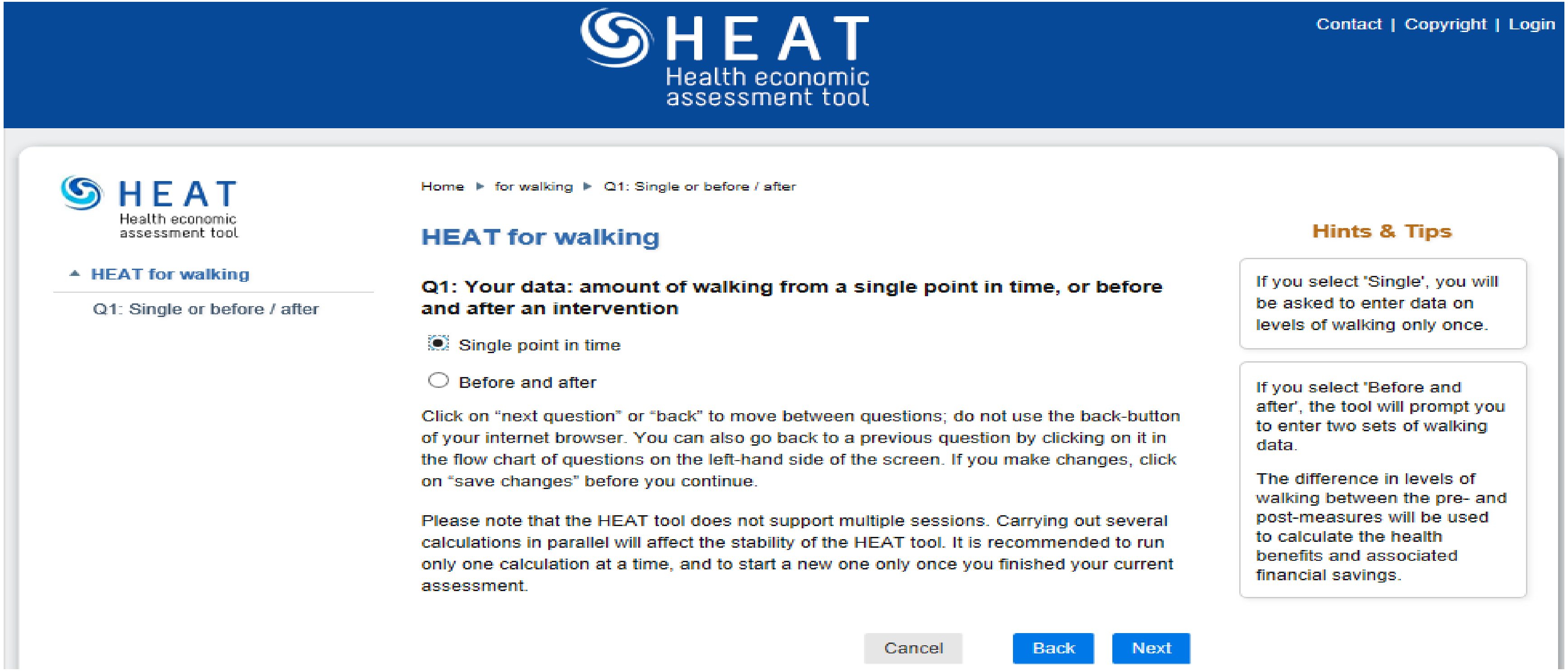
Scope for the use of HEAT Walking

Please read these explanations carefully to make sure HEAT is applicable to your case.

1) HEAT is to be used for assessments at the population level: for groups of people and not for individuals.

2) This tool is designed for habitual behaviour, such as walking for commuting, or regular leisure time activities.
Do not use it for the evaluation of one-day events or competitions (such as walking days

HEAT FOR WALKING & CYCLING: CASE STUDY



HEAT FOR WALKING & CYCLING: CASE STUDY

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Health economic assessment tool

- HEAT for walking
- Q1: Single or before / after
- Q2: Walking data type
- Q4: Distance

Home ▶ for walking ▶ Q2: Walking data type

HEAT for walking

Q2: Enter your walking data

The HEAT model requires an estimate of the average duration spent walking in the study population in order to calculate the corresponding health benefit (based on a relative risk from a review of the epidemiological literature on the health benefits of walking). This duration can be entered directly, if available (and this is the most direct data entry route), or calculated based on the distance, number of steps, or number of trips.

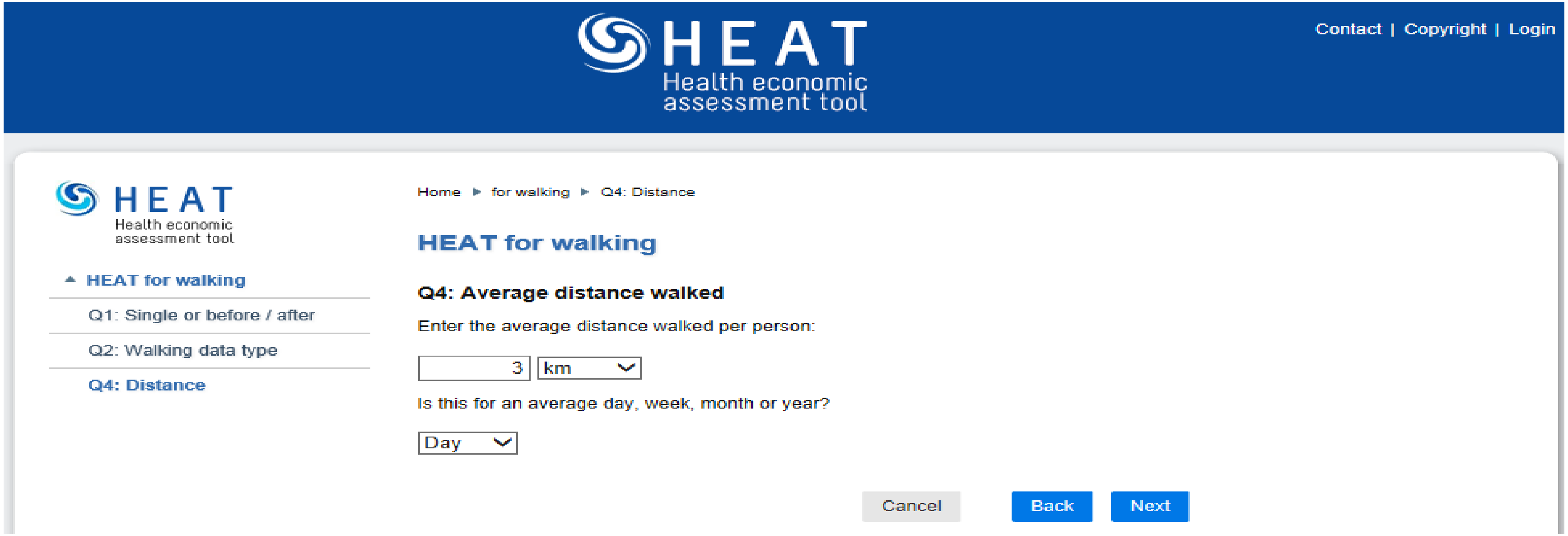
- Duration (average time walked per person)
- Distance (average distance walked per person)
- Steps (average number of steps taken per person)
- Trips (average per person or total observed across a population)

Cancel Back Next

Hints & Tips

More information on walking data
more...

HEAT FOR WALKING & CYCLING: CASE STUDY



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- HEAT for walking
  - Q1: Single or before / after
  - Q2: Walking data type
  - Q4: Distance
  - **Q7: Population**

Home ▸ for walking ▸ Q7: Population

HEAT for walking

Q7: How many people benefit?

The tool now requires information on the number of individuals doing the amount of walking you entered in the previous questions.

In most cases, this will also be the number of people who stand to benefit from the reported levels of walking. If the trips data you have entered is based on a representative sample of a larger population, you may need to change this number. In this case, you need to enter the total population number, rather than the number in your sample (e.g. in case of a national travel survey that is representative for the whole population, use the total number of population here, not the sample size of the travel survey). If you use survey data that has already been extrapolated to the whole population, the previously entered value is already the number of the total population and no change is required here.

It is important to ensure the right population figure is entered here, as this can substantially affect the resulting calculations.

Important note: Please bear in mind that HEAT works for averages across the population under study and not individual persons. The larger the study population is the more accurate the results will be.

Number of walkers:

100 persons*

* Please enter full number without delimiters such as commas or full stops

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HEAT FOR WALKING & CYCLING: CASE STUDY

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- HEAT for walking
  - Q1: Single or before / after
  - Q2: Walking data type
  - Q4: Distance
  - Q7: Population
  - Walking Summary

Home ▸ for walking ▸ Walking Summary

HEAT for walking

Summary of walking data

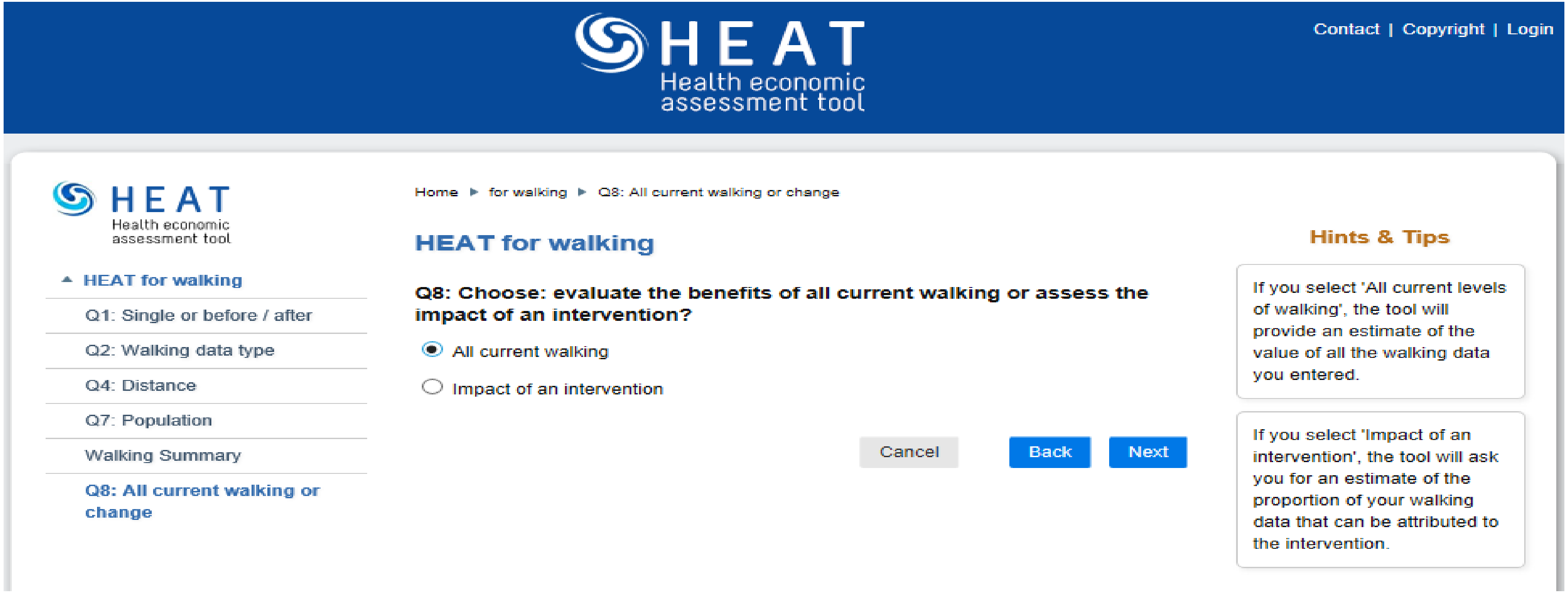
Review your entered data

Average distance walked per person per day in km: **3**
This level of walking is likely to lead to a reduction in the risk of mortality of: **17 %**
Total number of individuals regularly doing this amount of walking: **100**

Please bear in mind that HEAT is to be applied for assessments on a population level, i.e. in groups of people, not in individuals. HEAT does not calculate risk reductions for individual persons but an average across the population under study. The results should not be misunderstood to represent individual risk reductions.

Back | Next question

HEAT FOR WALKING & CYCLING: CASE STUDY



HEAT FOR WALKING & CYCLING: CASE STUDY

rates for an average population (about 20-74 years old), a younger average population (about 20-44 years old) or a predominantly older average population (about 45-74 years old).

Please choose for which age range you wish to carry out your calculation:

- ○ average population (about 20-74 years old)
- ○ younger average population (about 20-44 years old)
- ◉ older average population (about 45-74 years old)

Please enter a figure for mortality data either by selecting the value for your country from the WHO Mortality database, or by entering your own value. If your national value is not available, it is suggested to use the WHO European Region average value.

Select mortality data for your country using the drop down menu below:

Belgium (2010)

Your chosen rate is **812.70** deaths per 100,000 persons per year (crude rate)

Alternatively, you may enter your own value in the cell below:

0 deaths per 100,000 population

Cancel Back Next

More information on the recommended age range
more...

More information on death rates
more...

More than for cyclist example → because 74y is upper limit

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- HEAT for walking
  - Q1: Single or before / after
  - Q2: Walking data type
  - Q4: Distance
  - Q7: Population
  - Walking Summary
  - Q8: All current walking or change
  - Q11: Mortality rate
  - Q12: Value of life

Home ▸ for walking ▸ Q12: Value of life

HEAT for walking

Q12: Value of statistical life

What is the value of a statistical life?

The value of a statistical life is derived with a methodology called "willingness to pay" to avoid death in relation to the years this person can expect to live according to the statistical life expectancy[2]. Please bear in mind that such assessments do not assign a value to the life of one particular person but refer to an average value of a "statistical life". This will form the basis of the financial savings shown in the model.

Whenever possible, enter a country-specific value or use a country value from the drop-down menu (not available for Andorra, Monaco and San Marino). If not known, use the European default valuea of €2.487 million (WHO European Region), €3.387 million (EU-27 countries) or €3.371 million (EU-27 countries plus Croatia), respectively.

First, select the country for which you want to carry out your assessment, and choose the currency (local currency, EUR or USD).

Please enter the local value of statistical life:

Country: Belgium

Currency: European euro (EUR)

Value of statistical life: 4'380'597 EUR

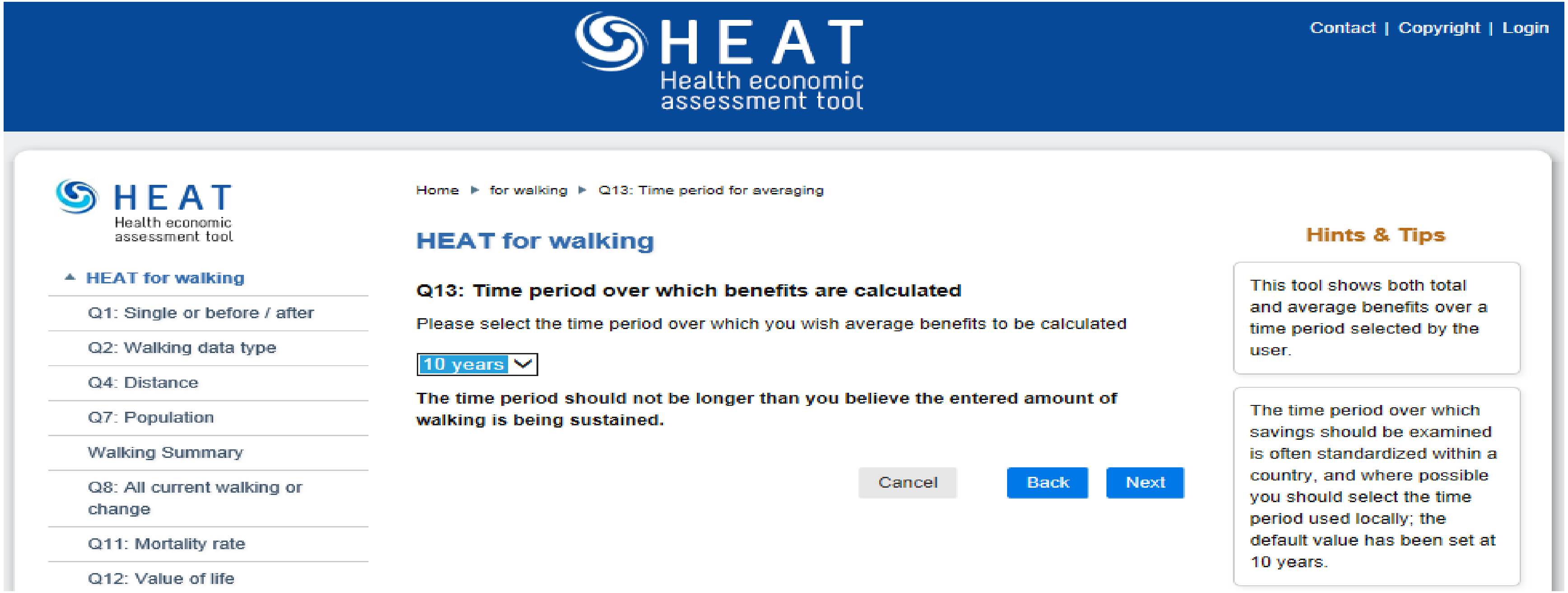
Cancel | Back | Next

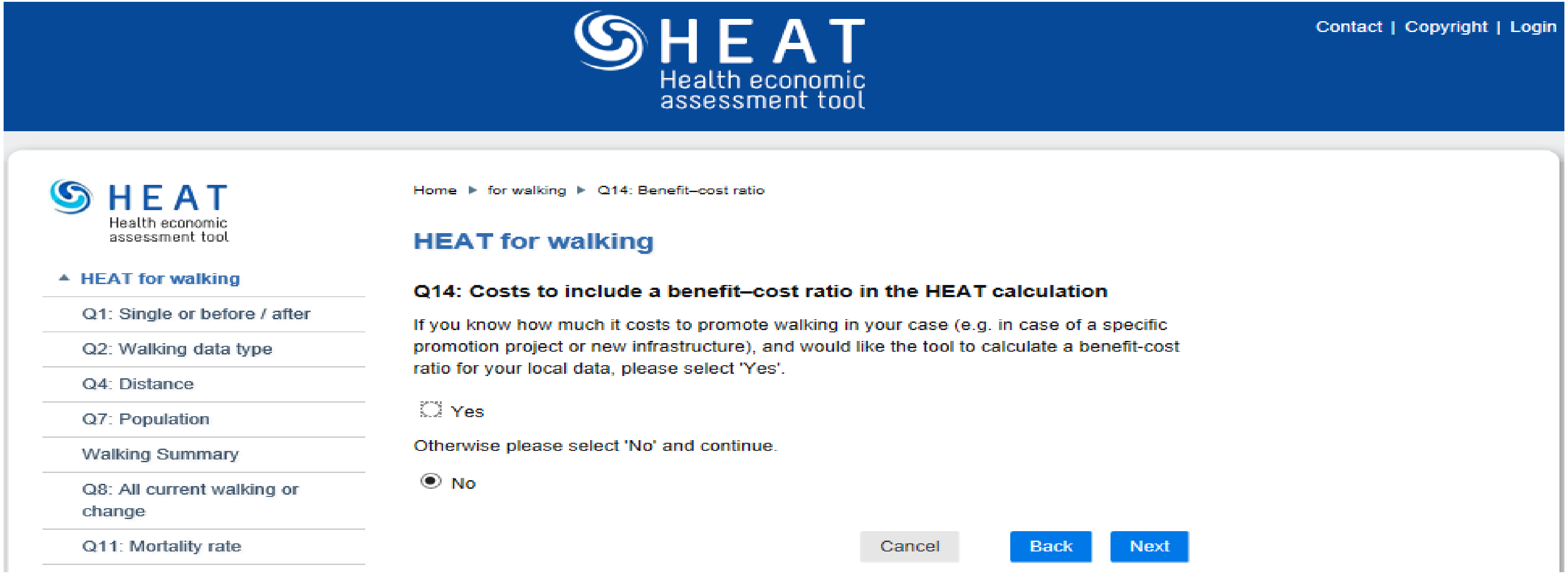
Hints & Tips

According to economic theory, the willingness to pay comprises lost consumption, immaterial costs (e.g. suffering) and the share of health costs paid directly by the victims[1].

more...

HEAT FOR WALKING & CYCLING: CASE STUDY

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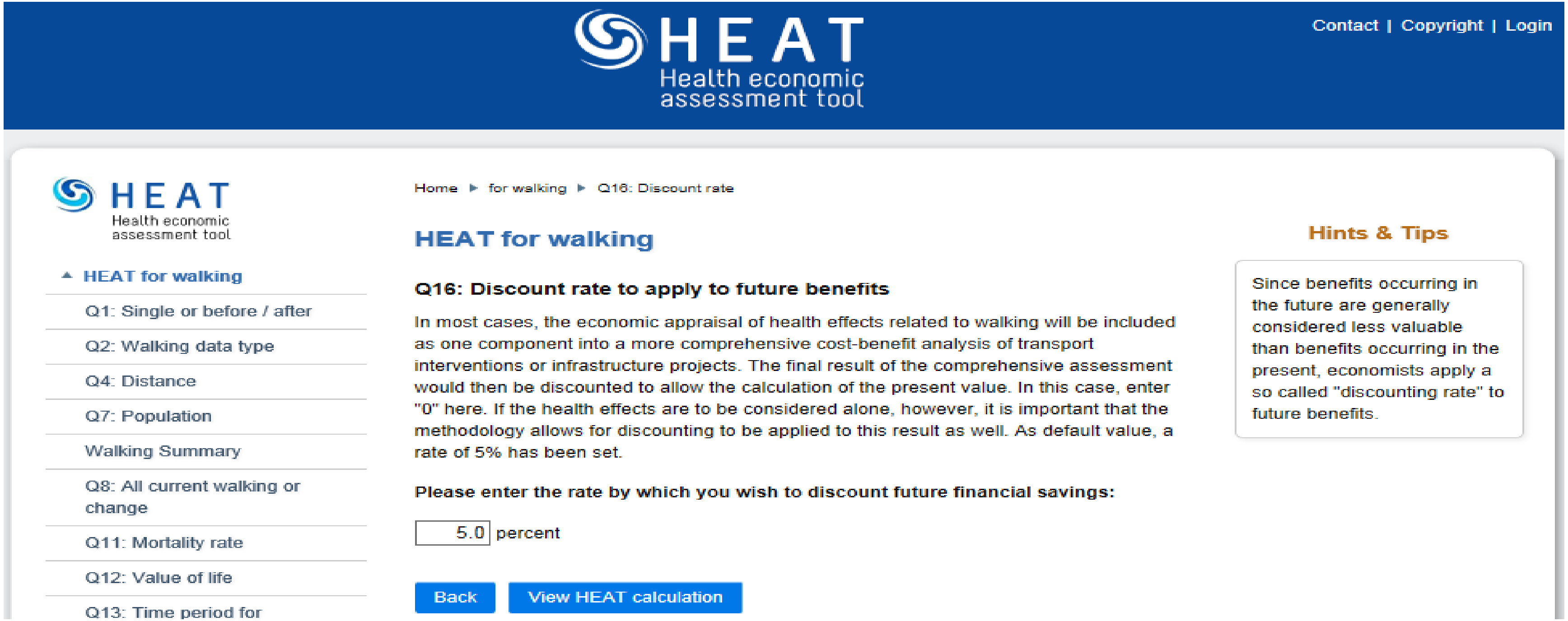
Walking Summary
Q8: All current walking or change
Q11: Mortality rate
Home ▶ for walking ▶ Q14: Benefit–cost ratio
HEAT for walking
Q14: Costs to include a benefit–cost ratio in the HEAT calculation
If you know how much it costs to promote walking in your case (e.g. in case of a specific promotion project or new infrastructure), and would like the tool to calculate a benefit-cost ratio for your local data, please select 'Yes'.
Yes
Otherwise please select 'No' and continue.
No
Cancel
Back
Next

HEAT FOR WALKING & CYCLING: CASE STUDY



HEAT FOR WALKING & CYCLING: CASE STUDY

HEAT estimate

Reduced mortality as a result of changes in walking behaviour

The walking data you have entered corresponds to an average of 3 km per person per day.

This level of walking provides an **estimated** protective benefit of: **17 %** (compared to persons not walking regularly)

From the data you have entered, the number of individuals who benefit from this level of walking is: **100**

Out of this many individuals, the number who would be expected to die if they were not walking regularly would be: **0.81**

The number of deaths per year that are prevented by this level of walking is: less than 1

Financial savings as a result of walking

Currency: EUR, rounded to 1000

The value of statistical life in your population is:	**4,381,000**
The annual benefit of this level of walking, per year, is:	**612,000**
The total benefits accumulated over **10** years are:	**6,119,000**
When future benefits are discounted by **5** % per year:	
the current value of the average annual benefit, averaged across 10 years is:	**472,000**
the current value of the total benefits accumulated over 10 years is:	**4,725,000**

SUMMARY & CONCLUSION

HEAT FOR WALKING & CYCLING: CONCLUSION

Input

- How many people walk/cycle?
- Time, distance or #trips
- Cost of Intervention
  - infrastructure
  - or promotion campaign

Defaults

- mortality rate
- VSL
- Time frame
- Discount rate

HEAT FOR WALKING & CYCLING: CONCLUSION

Output

- ‘Protective benefit’
- Average benefit per year (key output)
- Over longer period (default = 10 years)
- Discounted benefit per year
- (Cost-Benefit ratio)

Tool designed for transport planners
Evidence-based
Transparent
Simple to use

Order of magnitude only

World Health Organization
REGIONAL OFFICE FOR Europe

Health economic assessment tools (HEAT) for walking and for cycling

ECONOMIC ASSESSMENT OF TRANSPORT INFRASTRUCTURE AND POLICIES

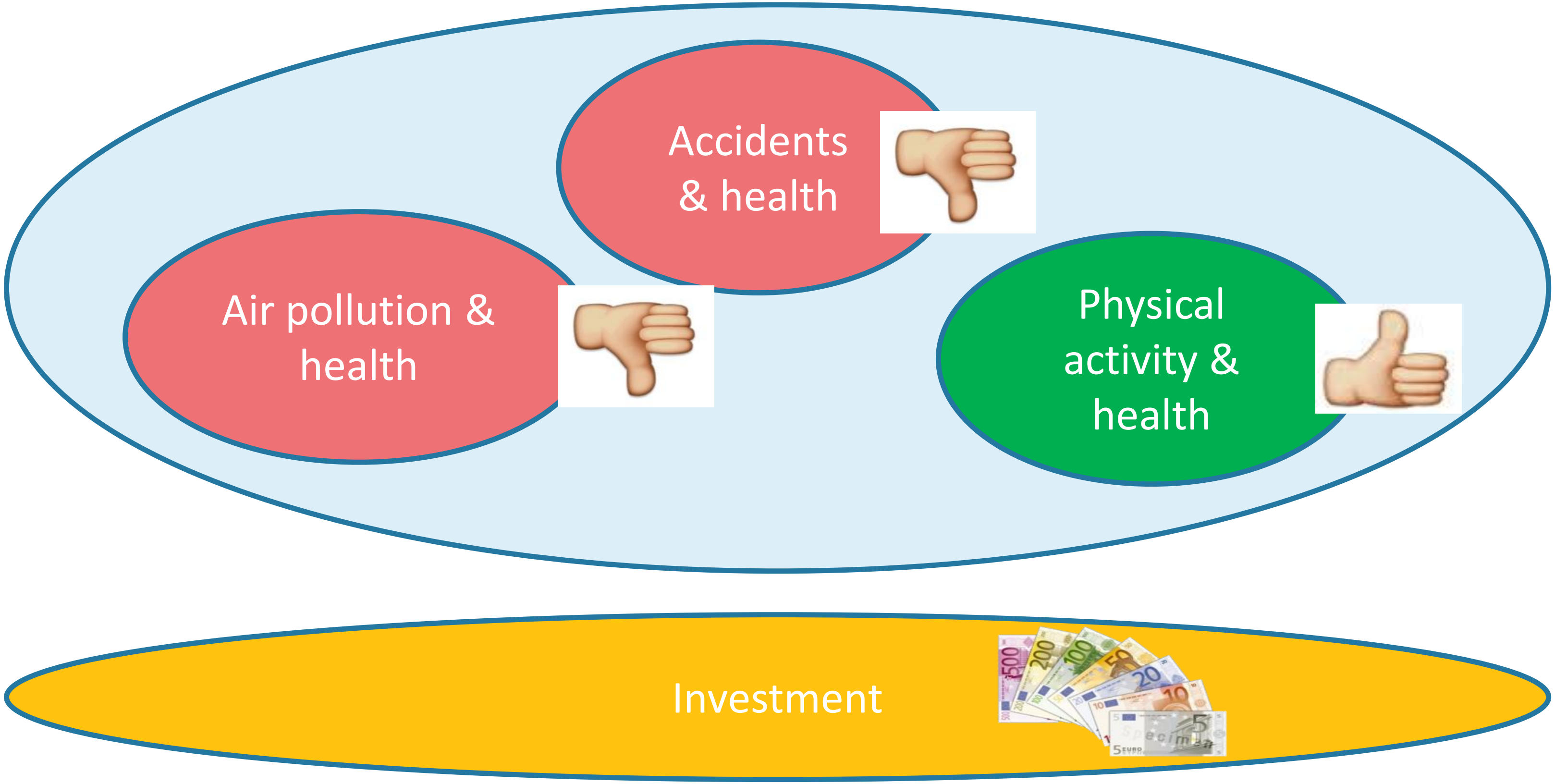
HEAT
Health economic assessment tool

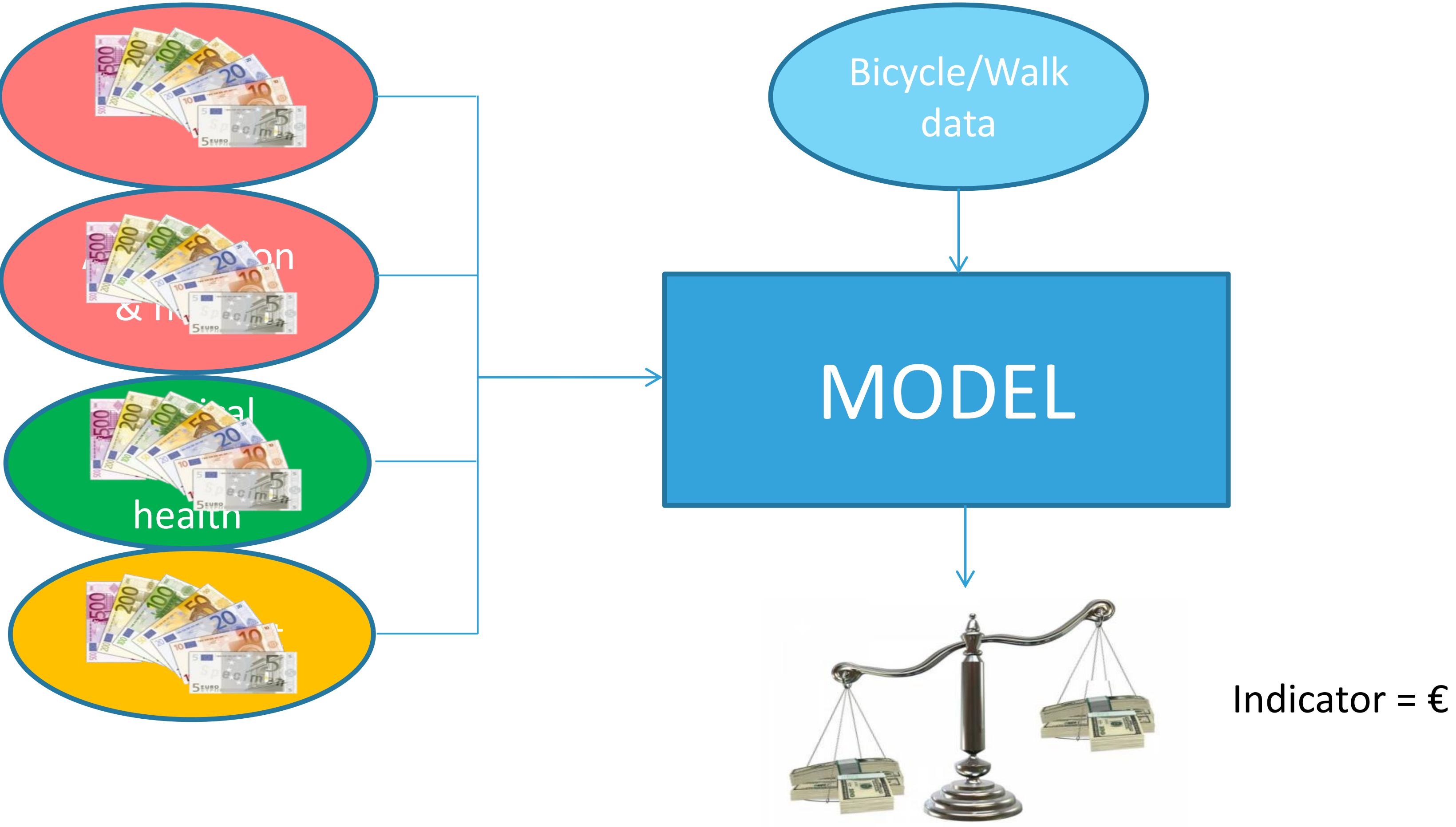
- **Introduction**
  - HEAT for cycling
  - HEAT for walking
- Current Assessment
- Previous Assessments
- Acknowledgements

More information

What data do I need?
To produce an assessment, you need to provide data on the number of people walking or cycling, and the amount of walking they are doing (or are projected to do).
more...

CWICALC: A DEDICATED MODEL FOR FLANDERS




Bicycle/Walk
data
MODEL
health
Indicator = €

HEAT compared to CWICalc

HEAT
Health economic assessment tool

- Estimate benefits of regular cycling/walking
- Estimate external benefits
- Compare with investment (e.g. building bicycle highway)
- *New update: including air pollution, accidents, climate (but not morbidity)*
- Order of magnitude
- VSL (country specific)

http://old.heatwalkingcycling.org

vito CWICalc

- Estimate benefits of regular cycling/walking
- DALY's & external benefits/costs
- Impact of increase in cycling accidents
- Impacts of air pollution: PM2.5
- Compare with investment (e.g. bicycle highway)
- YOLL & Cost of Illness & WTP (Willingness To Pay)
- VOLY (Flanders)
- Order of magnitude

\+ Mortality & Morbidity:
ischaemic HD, cancer (bowel, breast)
diabetes type II, depression,
dementia (>70j)

\+ Option: congestion, CO_2, noise

https://sites.google.com/site/cwicalc/input

Model specifics

- Adults

- Shift car => cycling / walking

- Establishing health benefits takes years

- Health benefit is capped

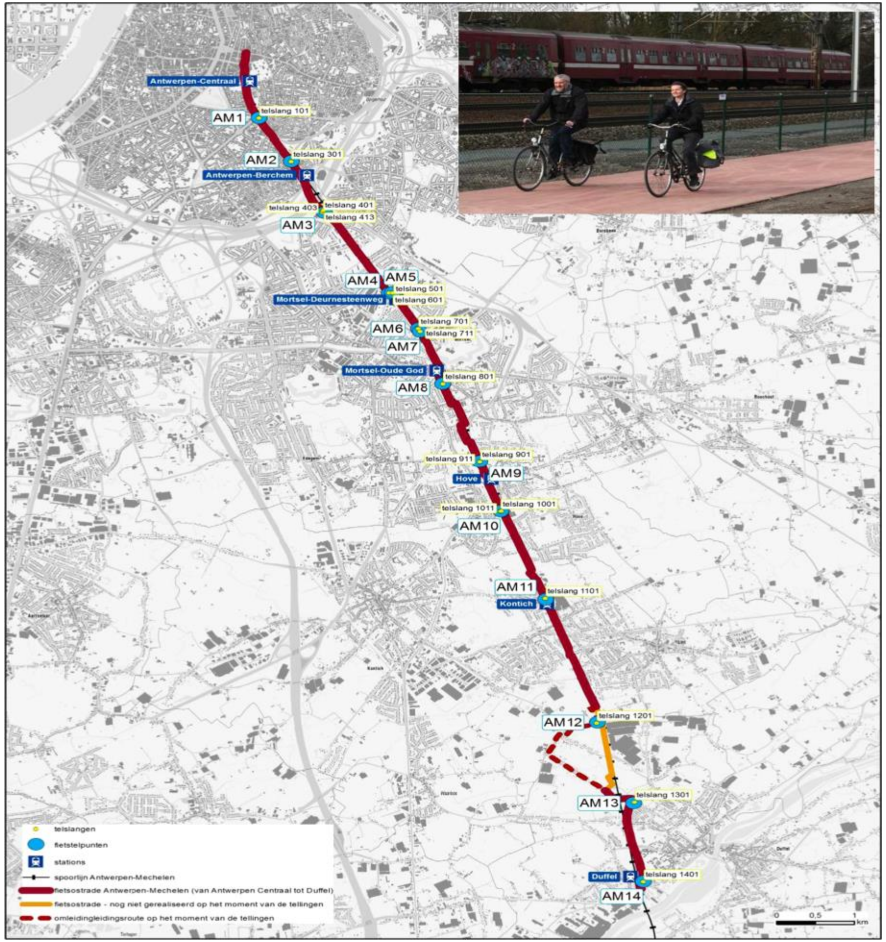
- VOLY: 40000 euro (some use up to 180000 euro; 40000 euro = conservative).

=> CWICalc is very conservative!

- Specifieke values for Flanders (Belgium). Treatment costs depend on national organisation of health care system

- Air pollution : PM2.5 only (WHO preferred indicator)

Counting cyclists on Bicycle highways



CWICalc application: fietsostrades / fietssnelwegen

Why Flanders?

- lots of data on cycling (counts)
- high air pollution
- data on accidents

- Scenario 1:
    - F1 Mechelen-Antwerpen
    - 600 cyclists
    - 27 km/day
    - 4 days per week
    - 20 year evaluation period
    - Building Cost: 6×10^6 Euro

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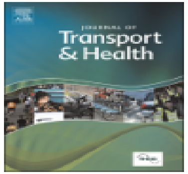

Health impact model for modal shift from car use to cycling or walking in Flanders: application to two bicycle highways

Jurgen Buekers [a,*], Evi Dons [a,b], Bart Elen [a], Luc Int Panis [a,c]

[a] Flemish Institute for Technological Research (VITO), Boeretang 200, 2400 Mol, Belgium
[b] Centre for environmental studies, Hasselt University, Agoralaan Building D, 3590 Diepenbeek, Belgium
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Crashes
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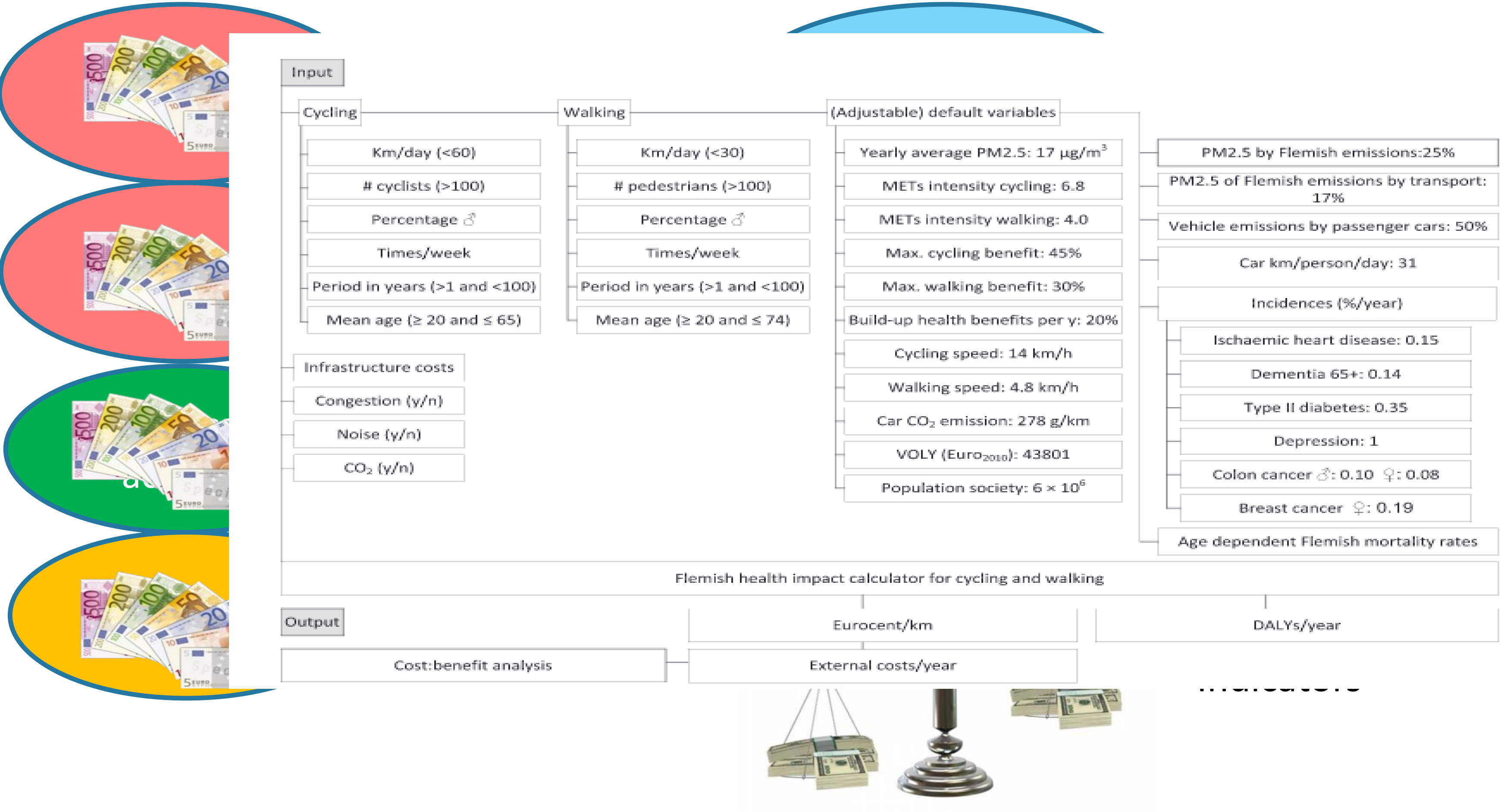
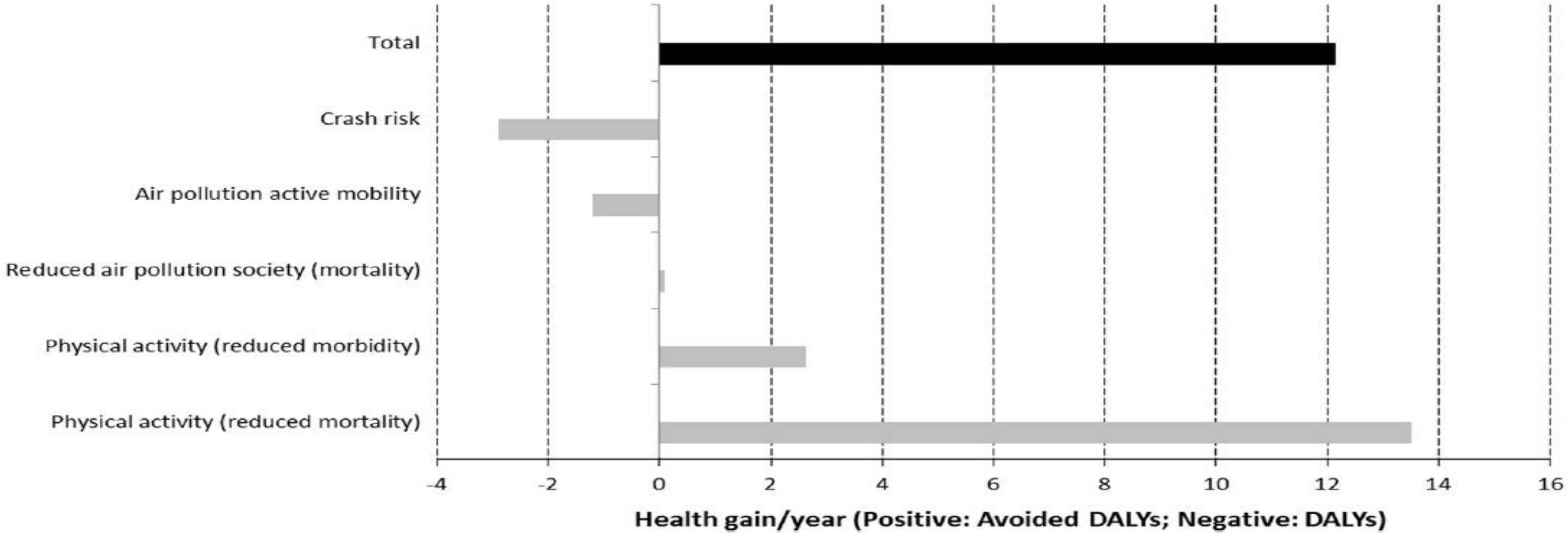
A B S T R A C T

In Flanders, a European hot spot for air pollution, alternatives to car transport are put in place to increase the daily level of physical activity (PA) among the population and reduce air pollution and global warming. To evaluate the economic impact of increased PA (cycling and walking), a health impact model was developed for a given volume of PA, relative to car use, within a defined population in Flanders. Flanders is an interesting region because of the combination of high air pollution, high cycling volumes and good data availability e.g on crashes and PA. The model uses two health indicators: external costs and DALYs. Considered impacts in the model are: mortality and morbidity related to increased PA, air pollution exposure for society and active individuals and crash risks. In addition to health, external costs for CO_2 emission, congestion and noise exposure can be considered. The model was applied to the new bicycle highways Antwerp–Mechelen and Leuven–Brussels, which were built near important traffic axes to provide the densely populated region with an alternative to car use. Different sensitivity analyses with a variable number of cyclists and travelled distances were elaborated to check the robustness of the results. Overall, the conclusion was that increased PA outweighed other impacts. The benefit:cost ratio

CWICALC MODEL



Results (DALY)



Crash risk over estimated or under estimated?

Results (costs in €)

Table 2
Direct and indirect (productivity loss) costs in Flanders (Belgium) for selected diseases. Cost are valid for the total period of illness and are expressed in euro 2010, if enough information was available for correction based on HICP[a].

Disease	Direct costs[b] in model	Indirect costs[b] (productivity loss) in model if selected age for physical activity is <65 years
Breast cancer	23,156	23,309
Colon cancer	33,930	116,022
Diabetes Type II	85,000	85,000
Depression	1984	5175
Dementia	183,000	–
Ischaemic heart disease	12,722	22,032

[a] Harmonised Indices for Consumer Prices; see: http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=prc_hicp_aind&lang=en
[b] Costs related to premature death are not considered here as they are already accounted for in the physical activity – premature mortality dose-response relationship.

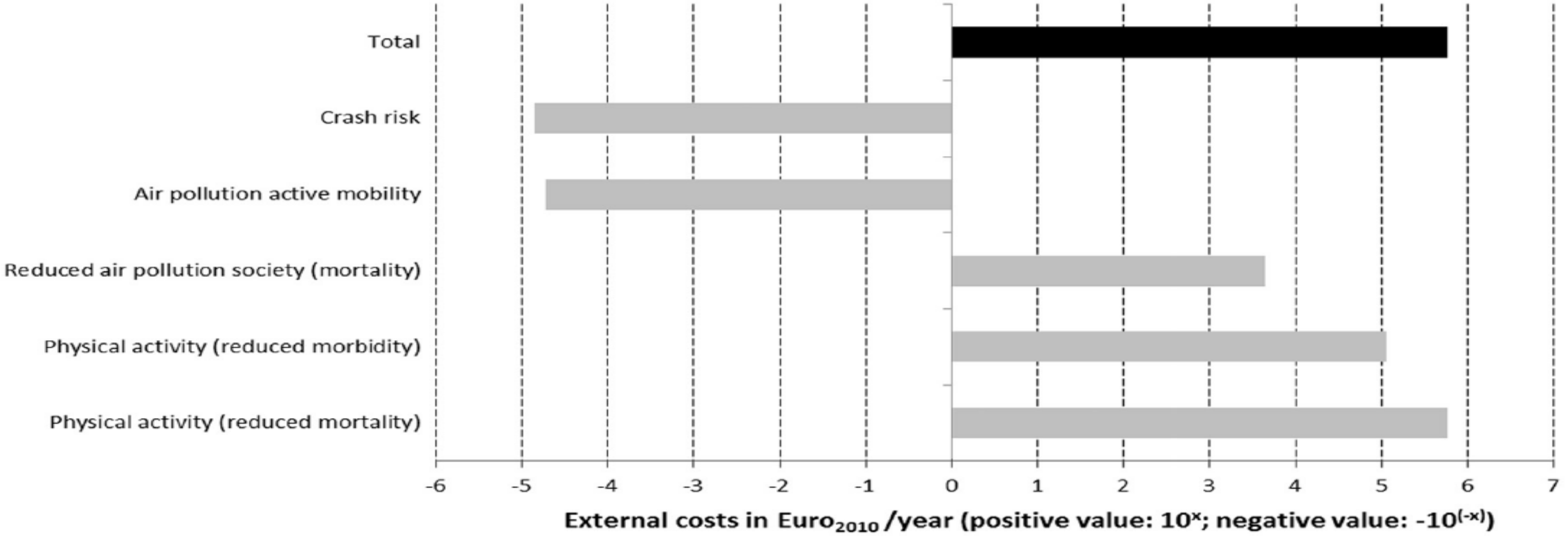
Costs of cycling accidents

	weight	Avg. cost (€)	CI_low (€)	CI_high (€)
NO_I	22.4%	295	157	476
LIGHT_I	47.5%	322	244	411
ABI_ST	25.7%	820	588	1089
ABI_LT	4.4%	9348	3764	17425
minor accident	100%	841	579	1205

- Risk of minor accident is 155 per million kilometers cycled (link)
  (one accident every **6500 km**)
- Risk of injury is 121 per million kilometers cycled
  (one injury each **8300 km**)
- Average cost of minor accident is 841 euro (vs €60.776 for major non-fatal accident)
  (**0.125 euro/ km**)
- Total cost of minor accidents in Belgium is 57 - 183 million € /year

Cycling highways expected to lower both the risk and the cost

Results (costs/benefits)



Results: (costs/benefits)

Table 4
Total benefits, external costs and cost:benefit analysis over 20 years for Antwerp–Mechelen bicycle highway (scenario 1[a])

Impact factor	euro
Physical activity (reduced mortality)	1.2×10^7
Physical activity (reduced morbidity)	2.3×10^6
Reduced air pollution society (mortality)	7.4×10^4
Air pollution active mobility	-8.9×10^5
Crash risk	-1.4×10^6
Total	$\mathbf{+1.2 \times 10^7}$
Infrastructure construction costs	-6.0×10^6
Benefit:cost ratio	**2.0**

[a] Scenario 1 with building costs for the bicycle highway set to 3×10^5 €/km (see Table 3)

Most scenarios positive.

CYCLING.BE

Fietsost
dik teru

14.12.2015 | ST

GAZET VAN ANTWERPEN

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OTHER SCENARIOS

Table 3
Benefit:cost ratios for different scenarios (number of cyclists and distance travelled) for the bicycle highways Antwerp–Mechelen and Leuven–Brussels and one hypothetical c
changed until the benefit:cost ratio equals one.

	Scenario	# cyclists (per day)	Travelled distance (km/day)	Benefit:cost ratio model for different building costs[a] A	B	Scenario remarks[b]
Antwerp–Mechelen	Scenario1	600	27	2.0	0.7	Average trip distance from a survey; minimum numb
	Scenario2	2600	12	4.7	1.8	For the 7 first counting points (AM1–AM7; See Fig. 2)
	Scenario3	4400	16	10.2	3.8	Own estimate of weighted average distance; maximu
	Scenario4	4400	27	14.5	5.4	Average trip distance survey; maximum number of c
Leuven–Brussels	Scenario1	500	37	1.5	0.6	Average trip distance from a survey; average number
	Scenario2	1100	37	3.4	1.3	Average trip distance from a survey; number of cycli
	Scenario3	1624	32	5.2	2.0	Own estimate of weighted average distance & numbe
Hypothetical	Scenario1	650	10	1.0		Number of cyclists changed until Benefit/Cost ratio e Travelled distance fixed at 10 km
	Scenario2	1700	10		1.0	Number of cyclists changed until Benefit/Cost ratio e velled distance fixed at 10 km
	Scenario3	350	20	1.0		Number of cyclists changed until Benefit/Cost ratio e Travelled distance fixed at 20 km
	Scenario4	950	20		1.0	Number of cyclists changed until Benefit/Cost ratio e velled distance fixed at 20 km

[a] A: building costs of highway equals 3×10^5 €/km; B: building costs of highway equals 8×10^5€/km. For the calculation of building costs of the bicycle highways a dista
model were: 50% of cyclists are males, distance is travelled 4 times/week, evaluation period is 20 years, mean age of the cyclists is 45 years. The impact of noise, congestion, C
ratios which is a conservative approach.

[b] Scenario data extracted from reports with statistical data on highway usage. All scenarios assume that if the trips were not made by bicycle, they would have been r

CONCLUSION

Research shows that cycling is healthier than not cycling

(If it increases the physical acitivity of sedentary people)

Air pollution

- Exposure peaks can be very high
- Physiological changes are evident
  - Scientifically challenging
  - May lead to clinical effects in the long term

⇒ Policy should reduce exposure (e.g. bicycle highways)

Accidents

- Risk of minor accident in general traffic is much higher than is higher than expected (even among experienced cyclists)
- Costs are high

=> Policy should eliminate conflicts, risks, consequences (e.g. bicycle highway design)

⇒<u>Cost efficient policies/infrastructure is possible</u>

⇒<u> Benefits almost always (much) higher than cost</u>

PASTA

PHYSICAL ACTIVITY THROUGH SUSTAINABLE TRANSPORT APPROACHES

More info

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Health impact model for modal shift from car use to cycling or walking in Flanders: application to two bicycle highways

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vito CWICalc

https://sites.google.com/site/cwicalcnederlands/input

HEAT Health economic assessment tool

oldheatwalkingcycling.org

Buekers J, Dons E, Elen E, Int Panis L. Health impact model for modal shift from car use to cycling or walking in Flanders: application to two bicycle highways. Journal of Transport and Health, 2,549-569,2015.

http://www.sciencedirect.com/science/article/pii/S221414051500674X

https://www.researchgate.net/publication/281612872_Health_impact_model_for_modal_shift_from_car_use_to_cycling_or_walking_in_Flanders_Application_to_two_bicycle_highways

Aertsens J et al. 2010. Commuting by bike in Belgium, the costs of minor accidents. Accident; analysis and prevention 42(6):2149-57

https://www.researchgate.net/publication/45799144_Commuting_by_bike_in_Belgium_the_costs_of_minor_accidents